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ABAG ASSOCIATION OF BAY AREA GOVERNMENTS

Charles R. Lewis, IV
Stanley R. Hoffman
Association of Bay Area Governments
Berkeley, California 94705

Jay Bodutch
City of Fairfield
Department of Environmental Affairs
Fairfield, California 94533

THE CRIS MODEL
A COST/REVENUE IMPACT SYSTEM FOR LOCAL JURISDICTIONS

ABSTRACT. The CRIS Model is a fiscal impact system for local jurisdictions designed to measure the public costs and revenues of land development and to review major operating or capital budget adjustments. The computer model was designed as a comprehensive financial tool for planners and public administrators by the Association of Bay Area Governments (ABAG) and the City of Fairfield, California. The Model can be used to analyze current and future costs for a variety of municipal services--such as police, education, fire and sewerage--and revenues from a variety of sources--such as property and sales tax, fees, service charges, and governmental grants. This paper describes the design and implementation of the model, and its ongoing application by Fairfield and other cities in the Bay Area.

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INTRODUCTION

The rapid growth of suburban communities over the last two decades has caused unplanned impacts on public service delivery and utility systems. Many communities began to deal with these impacts with traditional techniques such as density controls and building moratoria. Others reached out for newer techniques that were destined to be reviewed by the courts such as the imposition of growth rates or limits. Sometimes these approaches were successful; sometimes not.

In this atmosphere, the City of Fairfield and the Association of Bay Area Governments (ABAG) began to explore management techniques that would assist in implementing the City's General Plan for Cordelia, a new growth center. In the context of Fairfield's overall community goals, it was decided that the development must be fiscally sound and not place undue strains on the existing public service systems. The development of a system of financial accounts to analyze the costs and revenues resulting from new urban development seemed appropriate for these objectives. Over the course of the work program, the system of

financial accounts has acquired the general rubric of the "Cost Revenue Impact System" or simply the "CRIS Model."

The CRIS Model is a computer-based system designed to measure the costs and revenues associated with public decisions, especially land development decisions. It is a model because it attempts to replicate these public decisions regarding the provision of urban facilities and services and predict the capital and operating expenditures and revenues annually over a ten year period. It measures the public costs through a variety of procedural techniques commonly referred to as fiscal impact analysis. Basically then, the CRIS Model estimates the demand for new municipal services, such as schools, streets, parks, and sewers, and demands for increased service levels such as police, fire, recreation, and domestic water as a result of new residential and non-residential development.

The CRIS Model can be an important tool for both the city planner and city administrator and has been implemented and applied by the City of Fairfield and other jurisdictions in California. The original purpose of CRIS was to measure the impact of growth in terms of dollars of cost and revenue to a city or special district. However, the Model is also capable of maintaining and providing valuable information on equipment inventories, capital facilities, capital improvement programming, and personnel requirements. In addition, the CRIS Model can provide information concerning the relationship of costs and revenues for alternative development patterns and policy decisions. In summary, CRIS can be used in analyzing:

- current or new revenues
- major changes in operating or capital budgets
- capital improvement programming
- changes in levels of services provided
- annexations
- fiscal impact of individual land development proposals, including residential, commercial, and industrial projects
- fiscal impact of multiple land development proposals
- growth scenarios
- general plan updates or amendments

CONCEPTUAL DESIGN OF THE CRIS MODEL

There are several methods for estimating the costs and revenues associated with the operation of a particular public facility or service. These include estimates by local officials of the cost of providing additional services, the use of established or implicit standards which determine the level of services required for any development, and simple share allocation techniques which base the additional expenditures for new residents on the per capita cost of providing existing service. More sophisticated methods also include consideration of incremental costs and special demographic or income patterns of the new populations (1). However, all of these methods have inherent strengths and weaknesses.

The CRIS Model uses several of the methods described earlier. The use of several methods of cost/revenue analysis in the CRIS Model was a conscious attempt to incorporate the strengths of each technique to the specific estimation or projection situation involved.

The community standards method was used to estimate personnel or service requirements for the police and fire departments. This follows the generally accepted practice that departmental budgets provide an implicit standard of service level.

The incremental costs of adding additional units of service were used whenever possible. For example, for the sewer and water subsystems this was made possible by local engineering estimates for expanding existing facilities. In other cases, per unit measures had to be employed, such as for streets and roads where costs per lane mile were used.

The generation of revenue was based on local taxes, licenses, and fees related to development and municipal operations. For unpredictable flows of revenue such as federal grants, historic per capita ratios were used. The following is a general list of the revenue sources included in CRIS:

- property tax
- sales tax
- development fees
- Federal grants
- State subventions
- licenses and permit fees
- fines and penalties
- service charges
- transient occupancy tax
- business license tax
- franchise fees
- gas tax
- motor vehicle fees
- enterprise revenues
- interest income
- property transfer tax
- Proposition 13 bail-out funds

Flexibility is an important feature of the CRIS Model. Because it is a set of computer programs, it can be easily adapted to represent the decision-making and budgetary processes of any jurisdiction. After initial implementation in the City of Fairfield, it has been tailored to other jurisdictions.

CRIS MODEL INPUTS

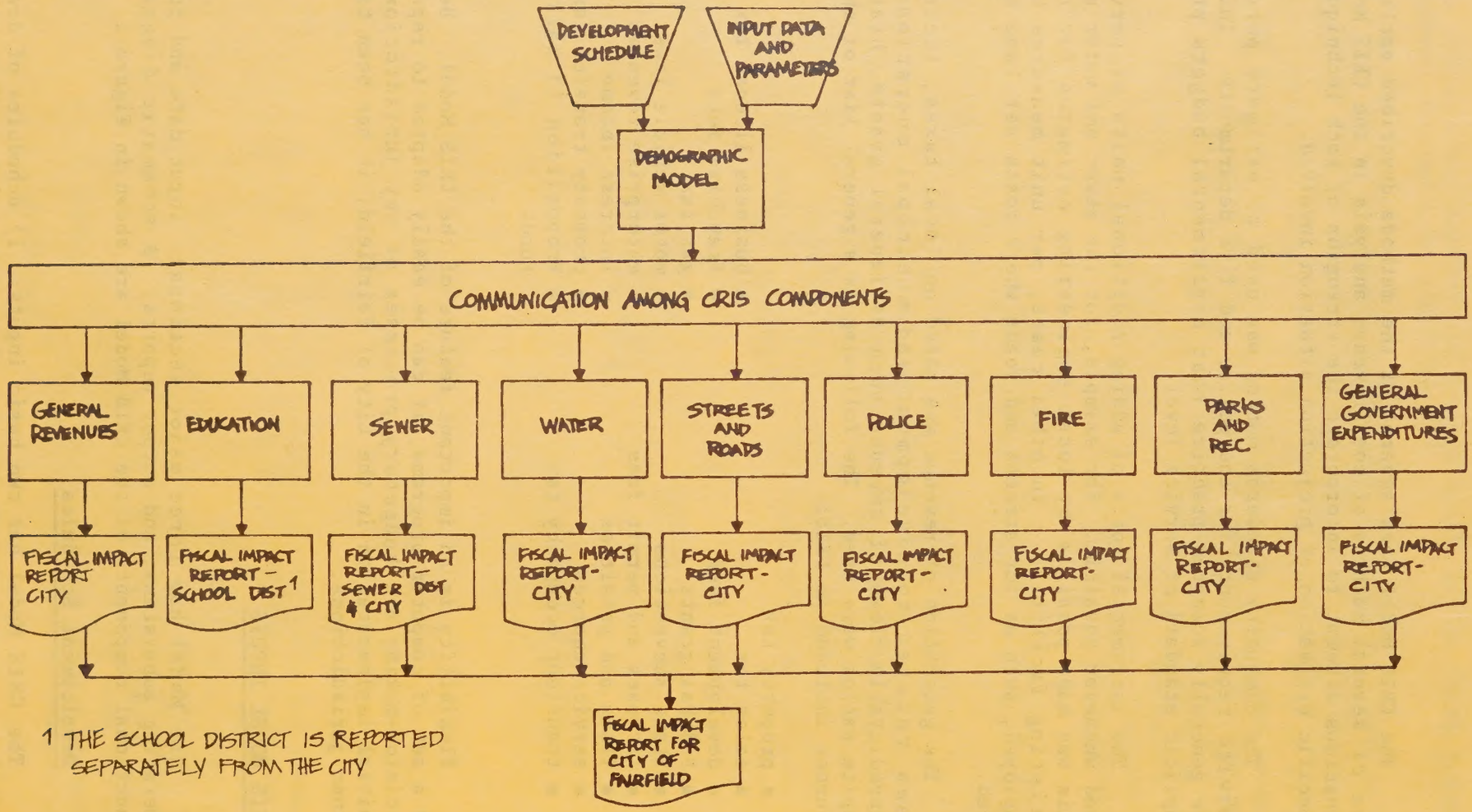
The Model has three major sections: input data and parameters, operating subsystems, and output reports. A schematic diagram of the functional components of the CRIS Model are shown in Figure 1.

Development Schedules

The CRIS Model has two basic inputs: 1) schedules of development, and 2) base data and parameters. The development schedules are the

FIGURE 1

FUNCTIONAL COMPONENTS OF CRIS



1 THE SCHOOL DISTRICT IS REPORTED SEPARATELY FROM THE CITY

driving force of the Model and consist of annual information regarding the nature and extent of proposed construction.

The CRIS Model disaggregates development schedules into three basic types: Residential, Commercial and Industrial. The schedules include information regarding the year of construction, the planning district or area of the city, the sewer and water pipe required, the lane miles of streets, the square footage of the structures, the acreage of the total development, and an estimate of market value of the structures.

The development schedules also contain information which is specific to each type of development. For example, in the residential schedule, housing units are distinguished by multiple- and single-family residences, and by number of bedrooms. Commercial development is divided into retail and office uses, while industrial development is divided into light and heavy industry.

The information for the development schedules could be supplied by the local planning department, city manager, developer, consultant, or special interest groups. A unique schedule is prepared for each development.

Base data and parameters

The second set of inputs to the CRIS Model is the base data and parameters. In order to project public service costs and local revenues for any analysis period, the model must have the initial values for all basic variables. These base conditions include current inventories of equipment, personnel classifications, school capacities and enrollment, and wage rates.

Input parameters are values which are assumed to remain constant during the projection period, such as the number of students per portable classroom or the average annual milage per police patrol vehicle. However, these parameters can be easily changed by the user for any of the projection years.

CRIS MODEL SUBSYSTEMS AND OUTPUT REPORTS

As was discussed earlier, the CRIS Model has several subsystems--only a few of these subsystems have been selected for review. A complete discussion of all the subsystems and their corresponding equations is contained in the CRIS project report (2). The demographic subsystem is described here because of it singular importance to the operation of all the other subsystems. The general revenue and fire subsystems have been included because they are emblematic of both the revenue and cost estimation techniques typical to the CRIS Model. Output reports from the Model have been included for both of the operating subsystems.

Demographics Subsystem

The demographic subsystem is at the heart of the CRIS Model. The intent of the CRIS Model is to replicate the budgetary decision process in local government rather than simply project future fiscal flows. In a real or political sense these decisions are made in response to demands by the citizens of the jurisdiction. Therefore it is essential to know the important components of that citizenry throughout the ten year analysis period in the Model. All of the data that is used by the other subsystems is accessed through the demographic submodel on each iteration of the CRIS Model.

The CRIS Model uses a modified cohort-survival model in the demographic subsystem. This cohort-survival model recognizes the basic components of population change: (1) increases in population resulting from births, (2) decreases in population due to deaths, (3) increases and decreases resulting from in- and out-migration, and (4) the aging process. The modification to a basic cohort-survival model includes a respecification of the cohorts as determined by the need of the education subsystem to calculate the number of students in each grade level. The age cohorts used in the CRIS Model are shown in the table below.

TABLE 1

CRIS DEMOGRAPHIC SUBSYSTEM AGE COHORTS

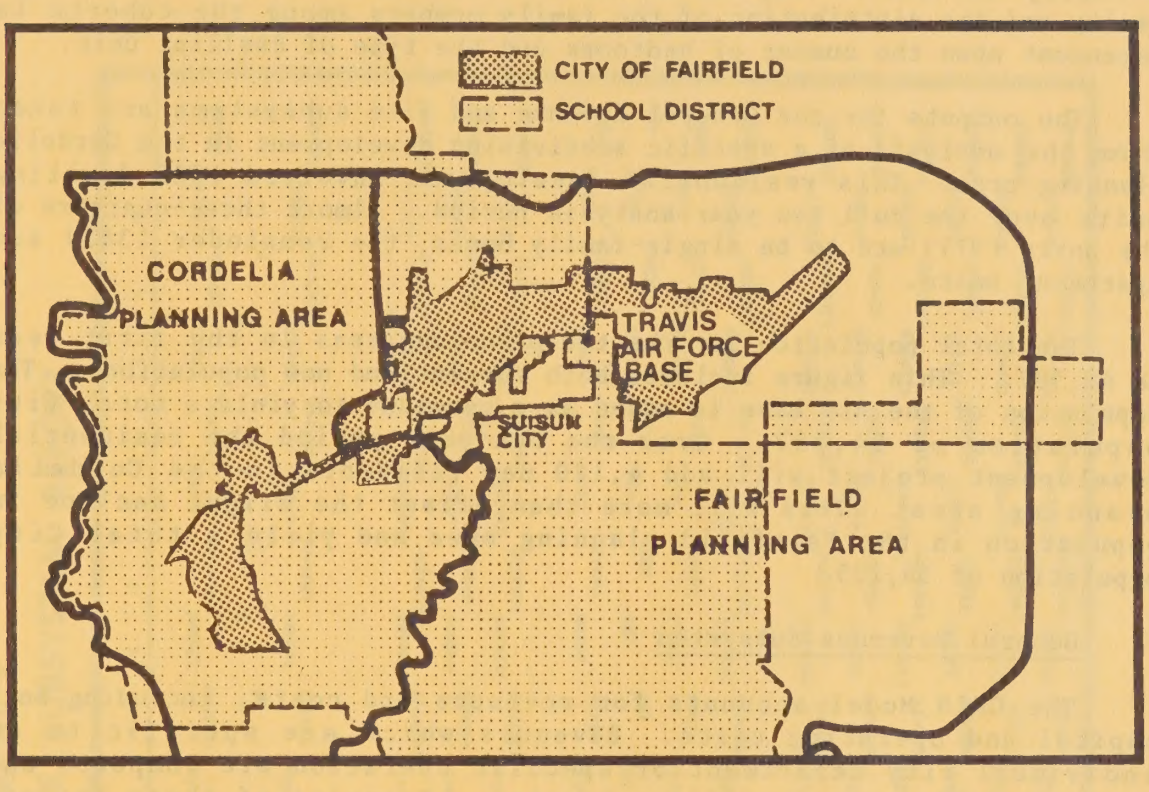
Cohort	Age	Description
1	0-4	Preschool Children
2	5-12	Grammer School Children
3	13-14	Intermediate School Children
4	15-18	High School Students
5	19-44	Young Adults
6	45-64	Middle Aged Adults
7	65+	Older Adults

The demographic subsystem keeps an accurate count of the existing and new population of the City of Fairfield. The subsystem also accounts for changes in the enrollment within the school district. For this purpose the City of Fairfield and the surrounding areas are geographically divided as shown in Figure 2.

The primary geographic areas are the Fairfield and Cordelia planning areas. Most of the current population of the City is located in the Fairfield planning area. However, the major portion of the new growth is expected in the Cordelia planning area.

FIGURE 2

GEOGRAPHIC DIVISIONS FOR CRIS



The population of the areas surrounding the City are used as necessary for specific computations. For example, the school district serves students in Fairfield, Suisun, and the unincorporated area and the sewer district serves both the City of Fairfield and Suisun City.

Travis AFB is located within the Fairfield planning area. The population of the base is expected to remain fairly constant at about 12,000 personnel. In some calculations the population of the base is included such as with computation of Federal revenue sharing. In other calculations, the Air Force personnel and their dependents are excluded. For example, the base has its own police, fire, and school systems.

The population is reported for the Fairfield and Cordelia planning areas. This was necessary because the two planning areas are approximately 14 miles apart and a school or fire station in one area cannot physically serve the population of the other area. Further, the populations are divided into current and new population. The distinction here is that new population accounts for those people who have just migrated to the planning area to occupy new development. Current population represents those individuals who have "lived" in the planning area for at least one year.

The Model disaggregates housing by type (single- and multi-family) and by the number of bedrooms within each type for residential development. When a development schedule is submitted the model creates a family for each newly constructed dwelling unit. The size of the family and the distribution of the family members among the cohorts is dependent upon the number of bedrooms and the type of dwelling unit.

The outputs for the General Revenue and Fire subsystems are taken from the analysis of a specific subdivision development in the Cordelia planning area. This residential development involved 1320 dwelling units over the full ten year analysis period. Almost three-quarters of the units (977) are to be single-family homes, the remainder (343) are apartment units.

The total population for the two planning areas in the first year is 42,507. This figure includes both current and new populations. The population of the air base is added as a constant to yield a total City population of 54,337. Over the ten-year period the residential development project will add 4,120 new residents in the Cordelia planning area. This will more than offset the slight decline in population in the Fairfield planning area and yield a total City population of 58,125.

General Revenues Subsystem

The CRIS Model accounts for revenues and costs, including both capital and operating costs. Revenues which are specific to an individual city department or specific operation are computed and reported within that specific subsystem. Examples of these include water connection and service charges (water subsystem) and a park dedication charges and swimming pool fees (parks and recreation subsystem). However, there are many revenues which are not specific to one department; these general revenues are computed in the general revenue subsystem.

The following output (Figure 3) is a simplified version of the report from the general revenue subsystem. This includes two basic types of revenues--those reserved for capital expenditures and those used primarily for operating expenditures. The first revenue shown on the output report is an example of a fee reserved for capital expenditures. The construction license revenue is used for the construction of new facilities such as new fire stations or bridges.

The second type of revenues--general revenues--are used primarily for operating expenditures. These are divided into four categories, (1) property taxes, (2) construction related revenues including all building permits (3) sales taxes, and (4) other revenues including service charges, fees, and revenues for other agencies. These revenues are added for each year to yield the total general revenues available for the operation of the City.

In the CRIS Model, the property taxes are divided into two groups--general property taxes and those required for debt service. The debt service property taxes are calculated by setting a tax rate which

FIGURE 3

GENERAL REVENUE SUBSYSTEM REPORT

GENERAL REVENUE	YEAR	1	2	3	4	5	6	7	8	9	10
A. CONSTRUCTION LICENSE REV.											
1. RESIDENTIAL		78400	230720	136800	191520	68000	146720	182560	107520	110400	96000
2. COMMERCIAL		0	0	0	0	0	0	0	0	0	0
CUMULATIVE LICENSE REVENUES		78400	309120	465920	657440	725440	872160	1054720	1162240	1272640	1368640
B. GENERAL REVENUES											
1. TAXES											
A. PROPERTY		1030476	1034999	1038108	1041854	1043596	1046490	1049986	1052093	1055726	1057446
B. DEBT SERVICE PROPERTY		498679	498679	498679	498679	498679	498679	498679	498679	498679	498679
TOTAL PROPERTY TAXES		1529155	1533678	1536787	1540533	1542275	1545169	1548665	1551572	1554405	1556125
2. CONSTRUCTION RELATED REV.											
A. BUILDING PERMIT REVENUE		14140	41612	26286	34542	2424	26462	32926	19392	4040	1010
B. CONSTRUCTION PERMIT FEE		259	377	259	259	113	377	377	529	113	67
TOTAL CONST. RELATED REV.		14399	41989	26536	34801	2537	26839	33303	19921	4153	1077
3. TOTAL SALES TAX REVENUE		2148807	2192433	2232754	2275233	2313354	2354633	2398143	2440848	2483541	2523937
4. OTHER REVENUE											
A. RECURRING SERVICE CHARGES		1282353	1299392	1311829	1325706	1331488	1341400	1352374	1360351	1368044	1371750
B. FEDERAL REVENUE		616724	624919	630901	637574	640355	645122	650400	654236	657936	659718
C. STATE REVENUE		1460035	1479435	1493599	1509395	1515978	1527263	1539758	1548840	1557608	1561818
D. ALL OTHER REVENUE		323848	328151	331292	334797	336257	338760	341531	343546	345489	346425
TOTAL OTHER REVENUE		3682960	3731897	3767617	3807472	3824078	3852545	3884063	3906973	3929069	3939711
TOTAL GENERAL REVENUE		7375321	7499997	7565697	7658039	7682244	7779186	7864174	7919314	7971168	8020850

is sufficient to meet that year's general obligation for each iteration of the Model. The general property taxes include both the distribution from the county as prescribed by California Senate Bill 154 and the additional revenue that can be expected from the new development.

The construction related revenue category includes building permits which are calculated and reported individually. All other construction permits, including heating, cooling, plumbing, electrical, and mechanical permits, are calculated individually but added before they are printed on the output report.

Sales taxes are calculated on the basis of the disposable income of the city's residents and the capture rate of local taxable purchases. The disposable income of the new residents is determined through the value of the housing units in the new development. Taxable purchases made in the City of Fairfield by non-residents is determined by using the population and disposable income of the county as a proxy for all non-resident consumers.

Fire Subsystem

The outputs for the operating departments of the City have two basic types of information--status and finances. This is exemplified by the fire subsystem. The first line of the output report as shown in Figure 4 contains information on the number of fire sub-stations in the city (two sub-stations existed in the first year). The remainder of the report shows the costs associated with the construction and operation of that service level.

The City of Fairfield is divided into seven substation service areas. At present there are stations in only two of these areas. As development occurs within the remaining substation service areas additional stations will be constructed. The timing of each station construction is dependent upon the degree of development within the specific service area. By policy of the city council, a new station is built when any one of three thresholds is reached within a particular area: total developed acreage, total number of residential units, or total development including commercial and industrial as well as residential development.

These specific thresholds have been programmed into the Fairfield CRIS Model so that the Model determines the timing of a substation construction. As shown in Figure 4, the residential development "trips" the threshold for total dwelling units in the second year of the project. This necessitates the construction of a $350,000 fire station and the purchase of $150,000 in new fire equipment. The $500,000 capital cost is reported in the second year.

The addition of a new fire station also increases the costs of operating the fire department. This change can be seen from the report by noting the difference in the costs for truck maintenance and operation, fire crews, and station maintenance. The total increase in the annual operating costs is about $146,000 for the additional station. The new annual operating costs for the fire department will stay

FIGURE 4

FIRE SUBSYSTEM REPORT

FIRE	YEAR	1	2	3	4	5	6	7	8	9	10
A. TOTAL SUb-STATIONS		2	3	3	3	3	3	3	3	3	3
B. COSTS											
1. CAPITAL COSTS											
A. SUB-STATION CAPITAL COSTS		0	500000	0	0	0	0	0	0	0	0
TOTAL CAPITAL COSTS		0	500000	0	0	0	0	0	0	0	0
2. OPERATING COSTS											
A. TRUCK MAINT. AND OPERATION		32502	37919	37919	37919	37919	37919	37919	37919	37919	37919
B. FIRE CREWS		651000	759500	759500	759500	759500	759500	759500	759500	759500	759500
C. STATION MAINTENANCE		64000	96000	96000	96000	96000	96000	96000	96000	96000	96000
D. HEADQUARTERS		83000	83000	83000	83000	83000	83000	83000	83000	83000	83000
TOTAL OPERATING COSTS		830502	976419	976419	976419	976419	976419	976419	976419	976419	976419
TOTAL COSTS		830502	1476419	976419	976419	976419	976419	976419	976419	976419	976419

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constant for as long as there are three stations in the department. When a new station is added the annual costs will increase by an additional increment.

CONCLUSIONS AND NEXT STEPS

Judging from the number of jurisdictions that have requested the implementation of the CRIS Model for their municipality, the interest in such a technique seems apparent. A computer-based model provides a systematic framework for structuring and analyzing a variety of data, assumptions and alternatives. However, cost/revenue analysis is only one of many techniques that should be utilized in determining future development plans. Cost/revenue analyses are made with a number of underlying assumptions that must be weighed in light of other non-fiscal issues.

The Model is being improved as experience is gained from transferring it to other jurisdictions and new capabilities are added to meet the variety of conditions and policies in these jurisdictions. A number of new subsystems have been or are being added to the original Model, including a marina, airport, sanitary landfill, and public transportation system.

Looking ahead, non-fiscal applications are being considered. For example, the Model could be used to calculate changes in energy demand for various land-use patterns. This and other applications are possible because the Model accounts for the major activities within a municipality or district.

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